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Quarterly Report

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Contract Number: DTPH56-05-T-0001

Prepared for: United States Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety

Project Title: "Understanding Magnetic Flux Leakage (MFL) Signals from Mechanical Damage in Pipelines"

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For quarterly period ending: September 30, 2006

Progress to Date

The objective of this project is to understand the origin of Magnetic Flux Leakage (MFL) signals from dents, with the ultimate goal being to accurately characterize dents from MFL field inspection data. MFL dent signals arise from both the dent geometry as well as the residual stresses surrounding the dent. In this project, experimental and finite element modelling techniques are used to separate and understand both stress and geometry contributions to the MFL signals.

Work conducted prior to the initiation of this contract by the Queen's University Applied Magnetics Group involved examination of MFL signals from circular dents. The first year of the current US DOT PHMSA cofunded effort involved extending this study to include "elongated" dents; specifically, dents having a 2:1 length to width aspect ratio. All prior first year work of the study involved "laboratory" dents produced in plates using a compression machine at Queen's University. The second (current) year of the PHMSA co-funded effort involves extending the study to examine dents in pipeline samples. Sections of dented pipeline will be provided by Gaz de France, who employ a specialized 'calibrated backhoe' unit designed to introduce realistic dents and gouges into pipe sections. As part of the second year of this effort, Queen's personnel will be travelling to the Gaz de France facilities in St. Denis, France to make MFL measurements on a number of pipeline sections containing well-characterized dents and gouges.

Research this quarter involved preparing and upgrading the MFL measuring equipment to make it more robust and portable for the trip to Gaz de France facilities, and to modify it to accommodate the larger geometry and curved nature of the pipeline sample coupons. In addition, the Infolytica MagNet magnetic modeling software license was renewed and considerable work was done to determine how best to build pipeline dent models using MagNet. Gaz de France also conducted stress FEA to provide the necessary inputs for Queen's magnetic FEA models.

A summary of the tasks conducted this quarter is given below:

Subtask 6.1 (Item 19) – Renewed the Infolytica MagNet Finite element software that is used for magnetic modeling of the MFL response from dents.

Subtask 6.2 (Item 20) – Upgrade MagNet models to accommodate the larger size and geometry of pipeline dents.

Subtask 6.3 (item 21) – Upgraded the MFL testing rig to make it more portable and ruggedized for travel, and to enable the measurement of large dents in curved pipe sections.

Subtask 6.4 (Item 22) – Gaz de France conducted stress analyses of dents to provide input for magnetic FEA models.

Task 4 (Item 23) – Documented quarterly activities and submitted quarterly status report to DOT.

Payable Milestones

The following payable milestones were completed during this reporting period:

- Renew finite element magnetic modeling software (Item No. 19)
- Upgrade magnetic models to accommodate larger backhoe dents (Item No. 20)
- Upgrade existing MFL testing rig to accommodate larger pipeline samples (Item No. 21)
- Stress FEA modeling of plain dents (Item No. 22)
- Sixth quarterly report submitted (Item No. 23)